

REMARKS

Applicants point out the Examiner has not provided any basis of rejection of claims 27, 29 and 30 in the Final Office action mailed Jan. 25, 2008 in violation of the requirement to provide a basis for rejection or a notice of allowable material for each and every claim pending in the application. Applicants believe that the Examiner must remedy this in a further office action.

Applicants have amended claims 11, 13, 15 and 19-24, and have canceled claims 1-10, 12 and 14 during prosecution of this patent application. Applicants are not conceding in this patent application that said amended and canceled claims are not patentable over the art cited by the Examiner, since the claim amendments and cancellations are only for facilitating expeditious prosecution of this patent application. Applicants respectfully reserve the right to pursue said amended and canceled claims, and other claims, in one or more continuations and/or divisional patent applications.

The Examiner rejected claims 11, 13, 18, 25 and 26 under 35 U.S.C. § 102(b) as allegedly being anticipated by Spikes et al. (US Pat. 5,981,354, hereinafter Spikes).

The Examiner rejected claims 11, 13, 14 and 17-24 under 35 U.S.C. § 102(b) as allegedly being anticipated by Karlsson et al. (US Pat. 6,124,183, hereinafter Karlsson).

Applicants respectfully inform the Examiner that claim 14 has been canceled.

The Examiner rejected claims 15 and 16 under 35 U.S.C. § 103(a) as allegedly being unpatentable over Spikes et al. (US Pat. 5,981,354).

The Examiner rejected claims 15, 16, 20 and 28 under 35 U.S.C. § 103(a) as allegedly being unpatentable over Karlsson (US Pat. 6,124,183).

Applicants respectfully traverse the §102(e) and §103(a) rejections with the following arguments.

First Rejection 35 USC § 102(b)

The Examiner rejected claims 11, 13, 18, 25 and 26 under 35 U.S.C. § 102(b) as allegedly being anticipated by Spikes et al. (US Pat. 5,981,354, hereinafter Spikes).

As to claim 11, the Examiner stated Spikes teaches “non-selectively removing, using a non-planarization process/etchback process, an entire uppermost layer of fill material from over first and second regions and top surface of planarization stop layer to form a thinned layer of fill material remaining over first and second regions and on top surface of planarization stop layer (col. 6, lines 40-42 and 46-47).” The Examiner also stated Spikes teaches “removing, using a planarization process (col. 6, lines 46-60 and fig. 8), all thinned layer of fill material 138 from top surface of planarization stop layer 114 and over first and second region.”

Applicants respectfully contend that Spikes does not anticipate claim 11, because Spikes does not teach each and every feature of claim 11. In a first example, Spikes does not teach “non-selectively removing, using a non-planarization process, an entire uppermost layer of said fill material from over said first and second regions and said top surface of said planarization stop layer to form a thinned layer of said fill material over said first and second regions and on said top surface of said planarization stop layer.”

First, Applicants point out in Spikes FIG. 7, a sacrificial layer 120 having a planer surface after reflow is formed on the trench dielectric layer 138 and that in FIG. 8, both the sacrificial layer 142 and trench dielectric layer 138 have been removed. In Spikes col. 6, lines 40-42 Spikes states “Turning now to FIG. 8, sacrificial dielectric layer 142 is entirely removed together with a portion of trench dielectric layer 138.” From FIG. 8, clearly the “portion of trench dielectric layer 138” referred to is that portion not filling trenches 124 and 126. All of the trench

dielectric layer 138 on polish stop layer 114 has been removed by CMP and non-planarization removal has been performed and no thinned layer of trench dielectric layer 138 has been formed.

Second, Spikes in col. 6, lines 46-48 teaches, “ In an alternative embodiment, etchback may be used in addition to the CMP to provide improved planarization.” Applicants point out that is a vague and ambiguous statement. It is not indicated whether the etchback or the CMP is performed first and assuming that the etchback is performed first, there is no teaching that the etchback results in thinning of trench dielectric layer 138 and not just sacrificial layer 142. Applicants respectfully submit that such thinning before CMP of the trench dielectric layer of Spikes is mere speculation on the part of the Examiner. Such a vague and ambiguous teaching in the prior art does not fulfill the requirement of a 35 USC 102 (b) prior art reference to identically disclose Applicants invention.

In a second example, Spikes do not teach “removing using a planarization process, all said thinned layer of said fill material from said top surface of said planarization stop layer and over said first and second regions.”

Applicants again point out that there is no clear teaching that there is any “thinned layer of said fill material” to be removed “using a planarization process” as Applicants claim 11 requires.

Based on the preceding arguments, Applicants respectfully maintain that Spikes does not anticipate claim 11, and that claim 11 is in condition for allowance. Since claims 13, 18, 25 and 26 depend from claim 11, Applicants contend that claims 13, 18, 25 and 26 are likewise in condition for allowance.

Second Rejection 35 U.S.C. §102(b)

The Examiner rejected claims 11, 13, 14 and 17-24 under 35 U.S.C. § 102(b) as allegedly being anticipated by Karlsson et al. (US Pat. 6,124,183, hereinafter Karlsson).

As to claims 11 and 22, the Examiner stated Karlsson teaches “(d), after (c): forming a mask layer 210 on fill material 208; forming a opening in mask layer in first region and over trenches of said first set of trenches (fig. 2H); removing a layer of fill material exposed in opening, fill material still completely filling each trench of said first set of trenches (col. 5, line 54-60 and fig. 2I); and removing masking layer (col. 5, line 60); and (e) after step (d), removing, using a planarization process (fig. 2J and col. 5, lines 60-65), all of fill material from top surface of planarization stop layer and over first and second set region, fill material still completely filling each trench of first set of trenches and each trench of second set of trenches, a top surface of fill material in first set of trenches and a top surface of fill material in second sets of trenches co-planer with top surface of planarization stop layer.”

As to claim 11, Applicants respectfully contend that Karlsson does not anticipate claim 11, because Karlsson does not teach each and every feature of claim 11. For example, Karlsson does not teach “a first thickness of said layer of said fill material directly over each trench of said first set of trenches greater than a second thickness of said layer of said fill material directly over each trench of said second set of trenches.” Applicants point out that FIGs. 2F, 2G and 2H clearly show that the thickness of insulating material 208 over trenches 205 and 206 being the same and not different and there is no teaching that seam 209 in insulating material over trench 205 and step 210 in insulating material over trench 206 result in any thickness differences. In col. 5, lines 36-39, all that Karlsson teaches is “Due to the nature of the insulating material 208,

after deposition the insulating material 208 has a seam 209 above each of the small trenches 205 and has a step 210 above each of the large trenches 206.” There is no teaching as to depths of seam 209 and step 210.

Applicants further point out, that Karlsson uses the same reference number for two different elements, step 210 and planarization layer 210 of FIGs. 2H and 2I rendering Karlsson ambiguous because it requires speculation on the part of the Examiner to determine exactly what elements referred to in the specification are shown in the drawings.

Based on the preceding arguments, Applicants respectfully maintain that Karlsson does not anticipate claim 11, and that claim 11 is in condition for allowance. Since claims 13, 17 and 18 depend from claim 11, Applicants contend that claims 13, 17 and 18 are likewise in condition for allowance.

As to claim 22, Applicants respectfully contend that Karlsson does not anticipate claim 22, because Karlsson does not teach each and every feature of claim 22, as amended. For example, Karlsson does not teach “after said removing of said layer of said layer of said fill material, said fill layer of material thicker over said planarization stop layer between adjacent trenches of said first set of trenches then over said fill material contained within each trench of said first set of trenches.”

Applicants respectfully point out that (1) Karlsson not teach “adjacent trenches of said first set of trenches” as Applicants claim 22 requires. Applicants point out that there are no two adjacent trenches 205 to each other in any drawing figure, but a trench 206 always intervenes. (2) Further, the thickness between any adjacent trenches Karlsson is the same as over any of the trenches of Karlsson.

Applicants contend the amendment of claim 22 is fully supported by FIG. 5B of Applicants drawings.

Based on the preceding arguments, Applicants respectfully maintain that Karlsson does not anticipate claim 22, and that claim 22 is in condition for allowance. Since claims 19-21, 23 and 24 depend from claim 22, Applicants contend that claims 19-21, 23 and 24 are likewise in condition for allowance.

As to claim 19, Applicants respectfully contend that Karlsson does not anticipate claim 19, because Karlsson does not teach each and every feature of claim 19. For example, Karlsson does not teach “after (d) and before (e), a first volume of fill material in said first region not completely contained in said trenches of said first set of trenches is about equal to a second volume of fill material in said second region not completely contained in said trenches of said second set of trenches.”

Applicants contend that there is no teaching in the specification or drawings of Karlsson of “after (d) and before (e), a first volume of fill material in said first region not completely contained in said trenches of said first set of trenches is about equal to a second volume of fill material in said second region not completely contained in said trenches of said second set of trenches.” Applicants request the Examiner distinctly point out where the alleged teaching is found in Karlsson.

Based on the preceding arguments, Applicants respectfully maintain that Karlsson does not anticipate claim 19, and that claim 19 is in condition for allowance.

As to claim 20, Applicants respectfully contend that Karlsson does not anticipate claim 20, because Karlsson does not teach each and every feature of claim 20. For example, Karlsson does not teach, “wherein (d) removes about 5 to 20% of the as deposited thickness of said fill material.”

Applicants contend that there is no teaching in the specification or drawings of Karlsson of “wherein (d) removes about 5 to 20% of the as deposited thickness of said fill material.” Applicants request the Examiner distinctly point out where the alleged teaching is found in Karlsson.

Based on the preceding arguments, Applicants respectfully maintain that Karlsson does not anticipate claim 20, and that claim 20 is in condition for allowance.

As to claim 21, Applicants respectfully contend that Karlsson does not anticipate claim 21, because Karlsson does not teach each and every feature of claim 21. For example, Karlsson does not teach “wherein (d) reduces the difference between a volume of said fill material over first region and a volume of said fill material over said second region.”

Applicants contend that there is no teaching in the specification or drawings of Karlsson of “wherein (d) reduces the difference between a volume of said fill material over first region and a volume of said fill material over said second region.” Applicants request the Examiner distinctly point out where the alleged teaching is found in Karlsson.

Based on the preceding arguments, Applicants respectfully maintain that Karlsson does not anticipate claim 21, and that claim 21 is in condition for allowance.

First Rejection 35 U.S.C. § 103(a)

The Examiner rejected claims 15 and 16 under 35 U.S.C. § 103(a) as allegedly being unpatentable over Spikes et al. (US Pat. 5,981,354).

The Examiner stated “Spikes fails to disclose the fill material is removed about 5 to 20% of the as deposited thickness (claim 15); and the aspect ratio of the first/second trenches (claim 16). It would have been obvious to one with ordinary skill in the art at the time of the invention to perform an etched back process step as taught by Spikes. The amount of the fill material being etched and the aspect ratio of the first/second trenches does not define patentable over Spikes since it is well-known processing variable and the discovery of the optimum or workable range involves only routine skill in the art. The specific amount of the semiconductor being etched does not provide any critical or unexpected results to the method of manufacturing a semiconductor device. Rather, it is merely an obvious selection of the etching amount based on desired functional characteristics determinable by routine experimentation. In *Aller*, the court stated, ‘Where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation.’ *In re Aller*, 220 F.2d 454, 456 105 USPQ 233,235 (CCPA 1995).”

As to claim 15, Applicants contend that claim 15 is not obvious in view of Spikes because Spikes does not teach or suggest every feature of claim 15. For example, Spikes does not teach or suggest, “wherein (d) removes about 5 to 20% of an as deposited thickness of said fill material.”

First, Applicants respectfully point out that Spikes is silent as the amount of material removed by the etch back process and in fact Spikes is not even clear as to what layer is

removed. The total teaching of Spikes relative to etchback is found in Spikes in col. 6, lines 46-48 which states, “In an alternative embodiment, etchback may be used in addition to the CMP to provide improved planarization” Thus the Examiner has not provided any evidence that the **amount** of material removed by the etchback is a well know process variable.

Second, Applicants contend that the Examiner has misapplied *In re Aller*. In discussing the basis for the opinion, *In re Aller* states “The process of appellants is identical with that of the prior art, except that the appellants’ claims specify lower temperatures and higher sulphuric acid concentrations **than are shown in the reference.**” Applicants point out that absolutely no values for the amount of “an as deposited thickness of said fill material” removed by the etch back process. Spikes must teach some numerical values for *In re Aller* to apply.

Based on the preceding arguments, Applicants respectfully maintain that claim 15 is not unpatentable over Spikes and is in condition for allowance.

As to claim 16, Applicants contend that claim 16 is not obvious in view of Spikes because Spikes does not teach or suggest every feature of claim 16. For example, Spikes does not teach or suggest “wherein the aspect ratio of trenches in said first set of trenches is greater than about 3:1 and the aspect ratio of trenches in said second region is less than about 3:1.”

First, Applicants respectfully point out that the total teaching relative to aspect ratios is “Shallow trench 124 is easier to fill than shallow trench 126 since shallow trench 124 is wider and has a smaller aspect ratio.” See Spikes col. 6, lines 8-10. Thus the Examiner has not provided any evidence that Spikes was in possession of any specific numerical aspect ratio relationship between high and low aspect ratio trenches or that this relationship was a well-known processing variable.

Second, Applicants contend that the Examiner has misapplied *In re Aller*. In discussing the basis for the opinion, *In re Aller* states “The process of appellants is identical with that of the prior art, except that the appellants’ claims specify lower temperatures and higher sulphuric acid concentrations **than are shown in the reference.**” Applicants point out that Spikes teaches no values for the relationship of between aspect ratios of wide and narrow trenches. Spikes must teach some numerical values for *In re Aller* to apply.

Based on the preceding arguments, Applicants respectfully maintain that claim 16 is not unpatentable over Spikes and is in condition for allowance.

Second Rejection 35 U.S.C. § 103(a)

The Examiner rejected claims 15, 16, 20 and 28 under 35 U.S.C. § 103(a) as allegedly being unpatentable over Karlsson (US Pat. 6,124,183).

The Examiner stated “Karlsson fails to disclose the fill material is removed about 5 to 20% of the as deposited thickness (claims 15&20); and the aspect ratio of the first/second trenches (claims 16&28). It would have been obvious to one with ordinary skill in the art at the time of the invention to perform an etched back process step as taught by Karlsson. The amount of the fill material being etched and the aspect ratio of the first/second trenches does not define patentable over Karlsson since it is well-known processing variable and the discovery of the optimum or workable range involves only routine skill in the art. The specific amount of the semiconductor being etched does not provide any critical or unexpected results to the method of manufacturing a semiconductor device. Rather, it is merely an obvious selection of the etching amount based on desired functional characteristics determinable by routine experimentation. In *Aller*, the court stated, ‘Where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation.’ *In re Aller*, 220 F.2d 454, 456 105 USPQ 233,235 (CCPA 1995).”

As to claims 15 and 20, Applicants contend that claims 15 and 20 is not obvious in view of Karlsson because Karlsson does not teach or suggest every feature of claims 15 and 20. For example, Karlsson does not teach or suggest, “wherein (d) removes about 5 to 20% of an as deposited thickness of said fill material.”

First, Applicants respectfully point out that in col. 5, lines 57-59, Karlsson teaches “the insulating material 208 is isotropically etched, as shown in FIG. 2I to remove **most** of the

insulating material 208 over polish stop layer 302 and the small trenches.” (1) The Examiner has not provided any evidence that the **amount** of material removed by an etchback is a well known process variable. (2) The “most” of Karlsson is teaching away from the “5 to 20%” of Applicants claims 15 and 20 since one of ordinary skill in the art would interpret “most” as being greater than 50% which is 10 to 2.5 times as much as Applicants claim.

Second, Applicants contend that the Examiner has misapplied *In re Aller*. In discussing the basis for the opinion, *In re Aller* states “The process of appellants is identical with that of the prior art, except that the appellants’ claims specify lower temperatures and higher sulphuric acid concentrations **than are shown in the reference.**” Applicants point out that absolutely no values for the amount of “an as deposited thickness of said fill material” removed by the etch back process. Karlsson must teach some numerical values for *In re Aller* to apply.

Based on the preceding arguments, Applicants respectfully maintain that claims 15 and 20 are not unpatentable over Karlsson and are in condition for allowance.

As to claims 16 and 28, Applicants contend that claims 16 and 28 is not obvious in view of Karlsson because Karlsson does not teach or suggest every feature of claims 16 and 28. For example, Karlsson does not teach or suggest “wherein the aspect ratio of trenches in said first set of trenches is greater than about 3:1 and the aspect ratio of trenches in said second region is less than about 3:1.”

First, Applicants respectfully point out that Karlsson is absolutely silent as the aspect ratios of trenches 205 and 206 no less the relationship between the aspect ratios of trenches 205 and 206. Thus the Examiner has not provided any evidence that Karlsson was in possession of

any specific aspect ratio relationship between high and low aspect ratio trenches or that this relationship was known to be a well-known processing variable.

Second, Applicants contend that the Examiner has misapplied *In re Aller*. In discussing the basis for the opinion, *In re Aller* states “The process of appellants is identical with that of the prior art, except that the appellants’ claims specify lower temperatures and higher sulphuric acid concentrations **than are shown in the reference.**” Applicants point out that Karlsson teaches no values for the relationship of between aspect ratios of wide and narrow trenches. Karlsson must teach some numerical values for *In re Aller* to apply.

Based on the preceding arguments, Applicants respectfully maintain that claims 16 and 28 are not unpatentable over Karlsson and are in condition for allowance.

CONCLUSION

Based on the preceding arguments, Applicants respectfully believe that all pending claims and the entire application meet the acceptance criteria for allowance and therefore request favorable action. If Examiner believes that anything further would be helpful to place the application in better condition for allowance, Applicants invite the Examiner to contact the Applicants' representative at the telephone number listed below. The Director is hereby authorized to charge and/or credit Deposit Account 09-0458 (IBM).

Respectfully submitted,
FOR: Economikos et al.

Dated: 3/19/08

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